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DWARF MISTLETOE IN THE NORTHERN REGION

By

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SUMMARY

Dwarf mistletoes are the most important disease organisms within the Northern Region; they reduce both height and diameter growth. An intensive control program extended over a prolonged period will help reduce the dwarf mistletoe infection level to the point where damage caused is held to a minimum. This objective can be reached through stand manipulation.

INTRODUCTION

Dwarf mistletoes (Arceuthobium spp.) are the most important disease organisms within the Northern Region. They cause reduction in diameter and height growth, and some mortality. Growth loss due to dwarf mistletoe is second only to that caused by heartwood decay fungi (1).

The dwarf mistletoes are native pathogens, and we have been living with them for many years in the Northern Region. Many billions of board feet have been harvested despite dwarf mistletoe, but we will not receive the highest possible yield with the present distribution and intensities of these pests. Demands for forest products are increasing, while the total area of commercial forest land is decreasing (13). Production must be increased on the available forest land, and management practices must be designed for the highest possible yield.

Dwarf mistletoes are amenable to silvicultural control. They are obligate,

parasitic seed plants, dependent upon their seed for reproduction and spread. Nature of seed dispersal is unfavorable for long-distance spread (4). Birds, rodents, and wind have no appreciable effect on seed dispersal (4). Dwarf mistletoe is destroyed by removal of infected host parts; therefore, it can be reduced to a tolerable level by killing infected trees or the infected portions of trees. Current control practices should be incorporated as an integral part of the forest management plans, and for economic reasons should be applied during the course of other management practices.

The first dwarf mistletoe control work in the Northern Region was undertaken in the fall of 1959 on the Deerlodge and Lewis and Clark National Forests (2). The treated blocks were lodgepole pine clearcuts (Figure 1). The blocks contained both residual trees and new reproduction about 4 to 12 years of age. An attempt was made to remove all visible infection from both age classes.

DISCUSSION

Causal agents, hosts, and their distribution is given in Table 1. See also Figures 2, 3, 4, and 5 for distribution (7).

Some information is available on the effect of dwarf mistletoe on growth loss and mortality. Studies on lodgepole pine (3) show a volume reduction of about 33 percent in mature, infected stands as compared with mature, healthy stands. Other studies on lodgepole pine (6) and Douglas-fir and western larch (9, 10, 14, 15) have shown marked reductions in height and diameter growth. A recent study in two adjacent western larch stands indicates that a healthy managed stand on a good site can produce, in 90 years, about seven times the volume of an unmanaged diseased stand (Figure 6)(9). In addition to losses of both diameter increment and height growth, dwarf mistletoes cause some mortality (5, 8). Infected trees also show a loss of vigor, increasing their susceptibility to attacks by other diseases and insects, and shortening the life expectancy of the stand (4, 8). A decrease in the quantity and quality of seeds produced by infected trees has been reported (8). Germination of seed from heavily infected ponderosa pine was only one-fourth that of uninfected trees (8).

The control of a parasitic organism such as dwarf mistletoe should be directed at the weakest point in its life cycle; present knowledge limits our control program to silvicultural practices. Through stand manipulation, the ultimate objective of reducing the dwarf mistletoes to an innocuous level can be achieved. This will necessitate an intensive program extended over a prolonged period. In the meantime, it will also be necessary to manage some of the existing stands with minimum control practices. This will achieve a dwarf mistletoe infection level whereby the damage caused is held to a minimum.

The dwarf mistletoe control program has increased in size, effectiveness, and expenditures. Table 2 gives a summary of Insect and Disease expenditures from FY 1966 to date. Average cost has been $17.00 per acre.

These are Insect and Disease funds only, and do not reflect the total amounts expended by the Forests for combined site rehabilitation and dwarf mistletoe control. Insect and Disease funds normally make up one-third of the total cost. The control of dwarf mistletoe in the Northern Region should now be considered a program, and not as individual projects. Proposed expenditures for FY 1973 through FY 1977 are given in Table 3.

CONTROL

The best control method for any disease is prevention. Assuming that even-aged stands are desirable, the best time for control (prevention of infection in the next rotation) is at the time of the regeneration cut.

Control Methods - Regeneration Cutting.--

Clearcut.--Pathologically, the highest level of dwarf mistletoe control is obtained with the clearcut method (Figure 7). As Smith (11) so aptly states, "the area is cut clear in the literal sense of the word; virtually all the trees, large or small, in the stand are removed in the process." This means complete removal of all non-merchantable material more than 2 feet in height as well as merchantable stems. To leave material standing because of small size, inferior species, poor quality, or pathological deterioration, represents "a very crude application of the selection method" (11) (Figure 8).

Seed Tree or Shelterwood.--Both of these methods are satisfactory if certain procedures are followed. In either case, all advanced reproduction more than 2 feet in height should be destroyed during or immediately following logging because much of it will be infected. The land manager can accomplish essentially the same level of dwarf mistletoe control with either of these methods as he can with the clearcut, if he provides for the prompt removal of the seed tree or shelterwood overstory as soon as it has served its purpose. That purpose is to provide a seed source and site protection for establishment of natural regeneration. Once regeneration is established, it is neither silviculturally, economically, nor pathologically sound practice to leave the overstory. Many seed tree and shelterwood areas have been forgotten, and the stands that could have been disease-free now are no better off pathologically than the original stands (Figure 9).

When practicing seed tree or shelterwood cutting methods, the land manager should always leave the best (healthy) individuals to produce the seed for the future crop, since there is a decrease in both the quantity and quality of seeds produced by infected trees (8).

Control Methods - Thinning.--Dwarf mistletoe infection can be reduced in a stand by thinning, where infected trees are removed in the thinning. The thinning should conform to timber management guidelines; i.e., thin only in young stands (less than 40 years old). The stand should be no more than moderately infected before treatment. Thinning in a heavily infected stand is not pathologically sound. The stand should be either left alone or wiped out completely. Determination

of degree of infection is difficult in a stand with a closed canopy because latent infections are not apparent for several years after the stand is opened by thinning.

If a merchantable product can be realized within 10 years, control should not be attempted until that time.

Selection of areas and control methods.--The types of areas, ranked by decreasing cost-benefit ratio, that qualify for dwarf mistletoe control are given in Table 4 with alternate control methods. Method A is preferable to Method B in all cases.

Control Surveys.--Presence or absence of dwarf mistletoe in categories 1-3 (Table 4) is sufficient information to decide for or against control. Intensive surveys are needed in categories 4-6 to determine if control is feasible. Stage II compartment examinations will indicate needs for further surveys. Current survey procedures in the Northern Region were designed by Toko and Carlson (12), but more refined methods are needed.

Shape and Size of Control Areas.--Careful selection of boundaries for control areas will do much to prevent spread of dwarf mistletoe back into the control areas. Natural barriers to seed dispersal, such as streams, meadows, lakes, ridge crests, rock outcrops, and timber type lines, should be used wherever possible. Man-made barriers, such as roads or other cleared rights-of-way, should also be used.

Shape of control areas is also important because of the amount of perimeter exposed to reinfection. The ideal shape of a control unit is circular, but this is usually impractical. A buffer strip of one chain is required around a control unit that does not utilize a natural boundary (4). The larger the size of the control unit, the smaller the percentage of the total area will be in the buffer strip. The multiple use concept and esthetic considerations may require adjustments in both shape and size of control units that would otherwise be optimum from a pathological basis.

Impact of Control on Other Resources.--Since control of dwarf mistletoe is normally accomplished in conjunction with silvicultural practices such as site rehabilitation or thinning, additional impact on other resources should not occur.

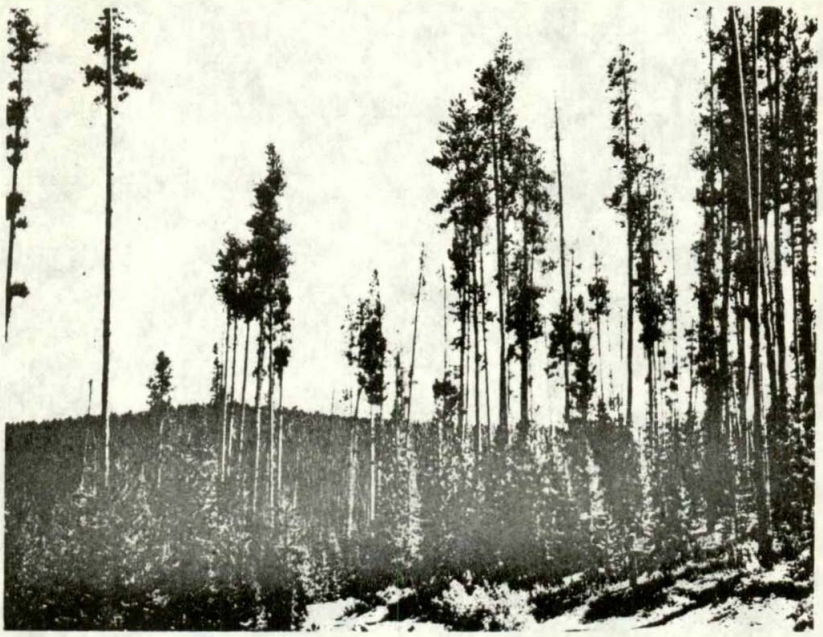

Figure 1. Economic clearcut. All merchantable trees were cut, but with the diseased overstory present, the young stand is also infected.

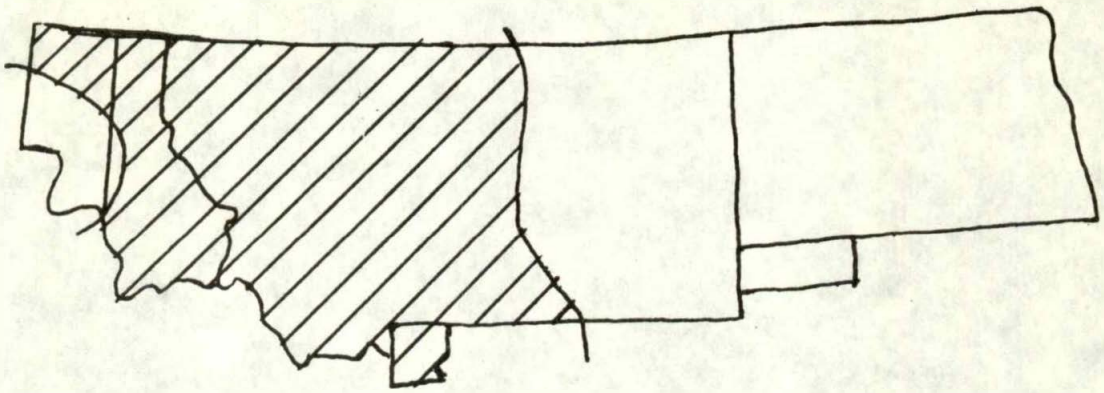

Figure 2. Distribution of Arceuthobium americanum on lodgepole pine in the Northern Region.

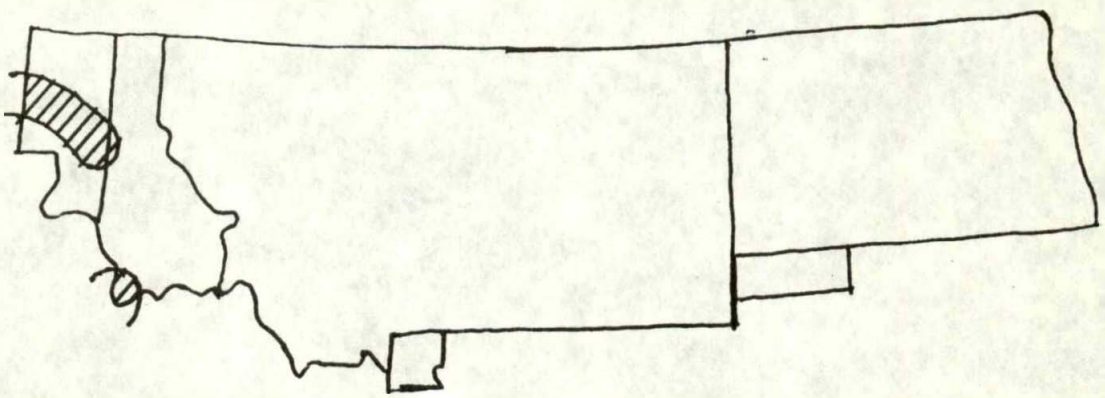

Figure 3. Distribution of Arceuthobium campylopodum on ponderosa pine in the Northern Region.

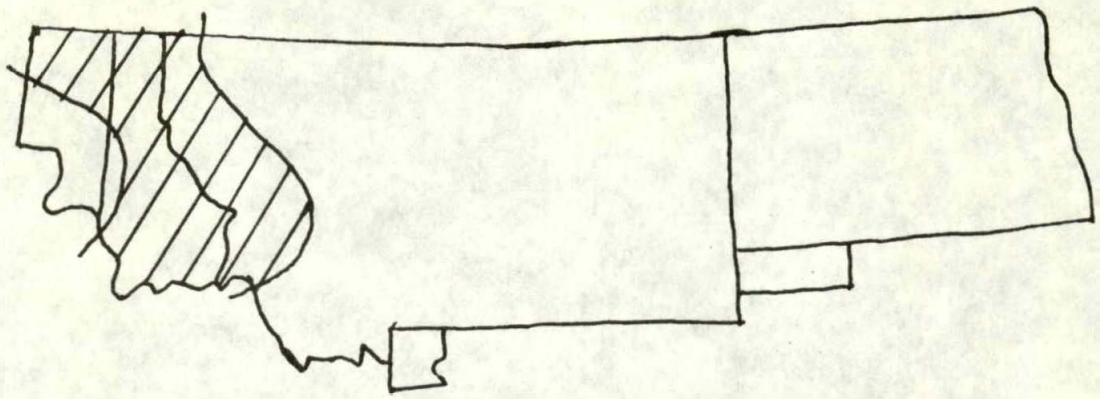

Figure 4. Distribution of Arceuthobium laricis on western larch in the Northern Region.

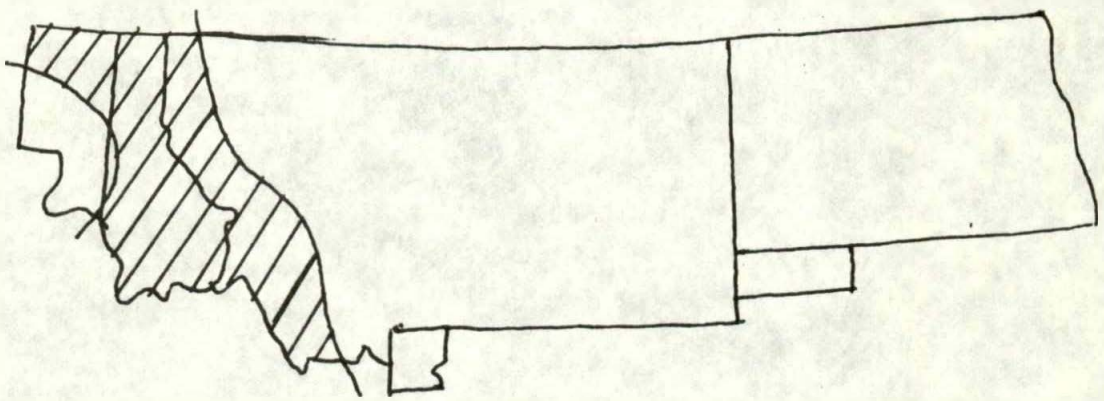

Figure 5. Distribution of Arceuthobium douglasii on Douglas-fir in the Northern Region.

Figure 6. Healthy stand of western larch on left (age 45) will produce seven times the volume of the diseased stand on right (age 90) with proper management (9).

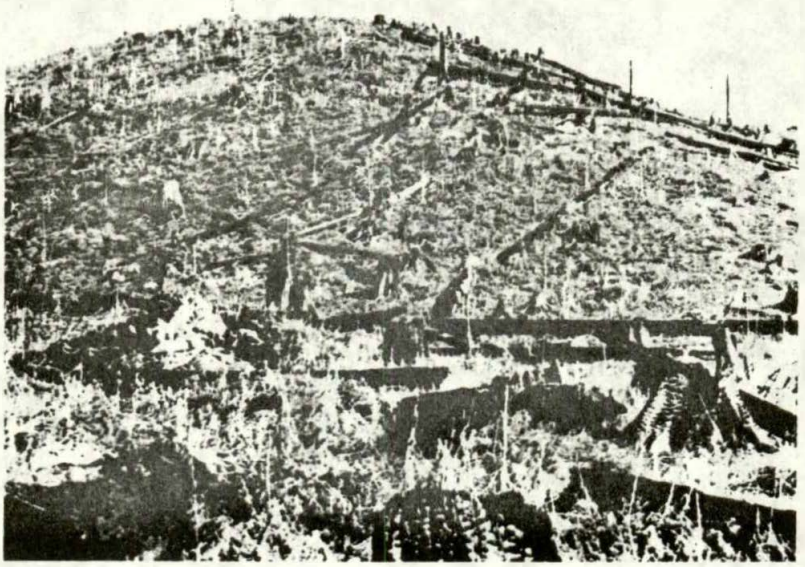

Figure 7. Pathologically, the highest level of dwarf mistletoe control is obtained with the clearcut method.

Figure 8. ". . . a very crude application of the selection method" (11).

Figure 9. Seed tree cut where diseased seed trees were left for seed. Young stand is no better off pathologically than the original stand.

TABLE 1.--Causal agents, hosts, and distribution of Arceuthobium in the Northern Region.

DWARF MISTLETOE SPECIES	HOSTS	DISTRIBUTION
Arceuthobium americanum Nutt. ex. Engel. Lodgepole pine dwarf mistletoe	Lodgepole pine. Occasional crossovers on ponderosa pine.	General through Montana, Idaho and eastern Washington.
Arceuthobium douglasii Engel. Douglas-fir dwarf mistletoe	Almost exclusively on Douglas-fir. Rarely on grand fir.	Idaho, eastern Washington, and western Montana. Not known to occur east of Continental Divide.
Arceuthobium laricis Western larch dwarf mistletoe	Western larch. Occasional crossovers on several other conifers. In some local areas, crossovers on lodgepole pine frequent.	Idaho, western Montana, and eastern Washington.
Arceuthobium campylopodum Engel. Ponderosa pine dwarf mistletoe	Ponderosa pine and lodgepole pine.	Eastern Washington and Idaho. Not known to occur in Montana.

TABLE 2.--Dwarf mistletoe expenditures, FY 1966 to FY 1972, in the Northern Region.

Forest	1966	1967	1968	1969	1970	1971 Request	1971 Alloted	1972 Request	1972 Tentative Allot.
Beaverhead	----	3,190	----	----	----	8,147	6,161	18,947	6,947
Bitterroot	----	----	----	8,547	----	-------	-------	81,400	7,900
Colville	----	1,500	----	----	12,205	9,982	9,928	3,705	3,705
Deerlodge	5,900	----	2,862	14,364	44,500	41,198	23,000	50,363	22,963
Flathead	----	----	----	----	----	-------	-------	6,857	6,857
Gallatin	----	11,922	4,270	3,680	778	24,034	13,427	59,947	21,947
Helena	----	----	----	3,000	----	-------	-------	28,090	8,990
Kaniksu	----	1,150	----	----	10,000	37,865	15,000	40,000	17,959
Kootenai	3,935	----	----	----	----	1,650	1,650	4,884	4,884
Lewis & Clark	----	----	----	----	----	-------	-------	19,567	7,967
Lolo	----	----	9,729	6,600	----	-------	-------	44,621	9,988
Nezperce	----	----	----	----	2,070	780	780	17,893	9,893
TOTALS	9,835	17,762	16,861	36,191	69,533	123,656	70,000	376,274	130,000

TABLE 3.--Dwarf mistletoe needs, FY 1973 through FY 1977, in the Northern Region.

Forest	Needs/Year[1/]	5-Year Total
Beaverhead	20,000	100,000
Bitterroot	20,000	100,000
Colville	20,000	100,000
Deerlodge	50,000	250,000
Flathead	20,000	100,000
Gallatin	50,000	250,000
Helena	20,000	100,000
Kaniksu	50,000	250,000
Kootenai	20,000	100,000
Lewis & Clark	20,000	100,000
Lolo	20,000	100,000
Nezperce	20,000	100,000
TOTALS	330,000	1,650,000

[1/] Adjustments may need to be made from year to year in actual allocations to the Forests, but total money needs will be the same.

TABLE 4.--Areas where control of dwarf mistletoe is feasible and methods for control in the Northern Region.

Type of Area	Methods of Control
1. Recent burns (within 5 years).	A. Remove residual trees when reproduction is established.
2. Recent clearcuts.	A. Destroy non-merchantable remaining stand (complete sanitation).
	B. Destroy unmerchantable remaining overstory, thin, and sanitize understory.
3. Seed tree and shelterwood cuts.	A. Leave the best trees for seed source; remove seed trees as soon as reproduction is established.
4. Thinning and control in stands under 20 years of age.	A. Remove overstory, thin, and sanitize desired age level.
5. Older burns (more than 5 years old).	A. Remove overstory, thin, and sanitize understory.
6. Thinning and control in stands 20 to 40 years old.	A. Remove overstory, thin, and sanitize desired age level.
	B. Delay control if a commercial thinning can be made within 10 years.

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